

What is claimed is:

1. A beam source comprising:
a plasma generating chamber;
a gas inlet port for introducing a gas into said plasma generating chamber;
a plasma generator for generating positive-negative ion plasma containing positive ions at a density of at least 10^{10} ions/cm³ and negative ions from the gas;
a plasma potential adjustment electrode disposed in said plasma generating chamber;
a grid electrode having a plurality of beam extraction holes formed therein, said beam extraction holes having a size of at least 0.5 mm; and
a first power supply for applying a voltage of at most 500 V between said plasma potential adjustment electrode and said grid electrode.

2. The beam source as recited in claim 1, wherein said plasma generator comprises:
a coil disposed near said plasma generating chamber; and
a second power supply for intermittently supplying a high-frequency current to said coil.

3. A beam source comprising:
a plasma generating chamber;
a gas inlet port for introducing a gas into said plasma generating chamber;
a plasma generator for generating positive-negative ion plasma containing positive ions and negative ions from the gas;
a plurality of grid electrodes each having a plurality of beam extraction holes formed therein; and
a first power supply for applying a voltage between said plurality of grid electrodes to accelerate the positive ions or the negative ions so as to pass through said beam extraction holes formed in said grid electrodes and to extract a neutralized beam from the positive ions or the negative ions or an ion beam.

4. The beam source as recited in claim 3, wherein said plasma generator comprises:
a coil disposed near said plasma generating chamber; and
a second power supply for intermittently supplying a high-frequency current to said

coil.

5. The beam source as recited in claim 3, further comprising a plasma potential adjustment electrode disposed in said plasma generating chamber,

wherein said first power supply applies a voltage between said plasma potential adjustment electrode and at least one of said grid electrodes.

6. The beam source as recited in claim 5, wherein said first power supply applies a low voltage such that accelerated ions do not practically sputter said at least one of said grid electrodes.

7. The beam source as recited in claim 3, wherein said pluralities of beam extraction holes in said plurality of grid electrodes are aligned with each other.

8. The beam source as recited in claim 3, wherein said plurality of beam extraction holes in at least one of said grid electrodes has an aspect ratio of at least 10.

9. A beam processing apparatus comprising:

a vacuum chamber;

a holder disposed in said vacuum chamber for holding a workpiece; and

a beam source for applying a beam to the workpiece held by said holder, said beam source comprising:

a plasma generating chamber;

a gas inlet port for introducing a gas into said plasma generating chamber;

a plasma generator for generating positive-negative ion plasma containing positive ions at a density of at least 10^{10} ions/cm³ and negative ions from the gas;

a plasma potential adjustment electrode disposed in said plasma generating chamber;

a grid electrode having a plurality of beam extraction holes formed therein, said beam extraction holes having a size of at least 0.5 mm; and

a first power supply for applying a voltage of at most 500 V between said plasma potential adjustment electrode and said grid electrode.

10. The beam processing apparatus as recited in claim 9, wherein said plasma generator comprises:

- a coil disposed near said plasma generating chamber; and
- a second power supply for intermittently supplying a high-frequency current to said coil.

11. A beam processing apparatus comprising:

- a vacuum chamber;
- a holder disposed in said vacuum chamber for holding a workpiece; and
- a beam source for applying a beam to the workpiece held by said holder, said beam source comprising:

- a plasma generating chamber;
- a gas inlet port for introducing a gas into said plasma generating chamber;
- a plasma generator for generating positive-negative ion plasma containing positive ions and negative ions from the gas;

- a plurality of grid electrodes each having a plurality of beam extraction holes formed therein; and

- a first power supply for applying a voltage between said plurality of grid electrodes to accelerate the positive ions or the negative ions so as to pass through said beam extraction holes formed in said grid electrodes and to extract a neutralized beam from the positive ions or the negative ions or an ion beam.

12. The beam processing apparatus as recited in claim 11, wherein said plasma generator comprises:

- a coil disposed near said plasma generating chamber; and
- a second power supply for intermittently supplying a high-frequency current to said coil.

13. The beam processing apparatus as recited in claim 11, further comprising a plasma potential adjustment electrode disposed in said plasma generating chamber,

wherein said first power supply applies a voltage between said plasma potential adjustment electrode and at least one of said grid electrodes.

14. The beam processing apparatus as recited in claim 13, wherein said first power supply applies a low voltage such that accelerated ions do not practically sputter said at least one of said grid electrodes.

15. The beam processing apparatus as recited in claim 11, wherein said pluralities of beam extraction holes in said plurality of grid electrodes are aligned with each other.

16. The beam processing apparatus as recited in claim 11, wherein said plurality of beam extraction holes in at least one of said grid electrodes has an aspect ratio of at least 10.